CHAPTER 7

ALTERNATIVE TREATMENT SCHEMES

A. INTRODUCTION

Based on the information previously presented, this chapter will enumerate and evaluate several viable treatment alternatives for the CIWC – Vermilion County Division. These alternatives utilize both surface water and groundwater as a sole and blended source and examine various modes of treatment of these waters.

B. DESIGN CRITERIA

The following table represents the major design criteria for the alternative solutions proposed.

TABLE 7-1
DESIGN CRITERIA

Water Quality Parameter	Maximum Contaminant Level (MCL)	GOAL
Effluent Nitrate (mg/l as N)	<10	<9
Turbidity (NTU)	<0.3	<0.2
Effluent THM (µg/l)	80	<40
Other Design Parameters	**Goal**	
Flow (mgd)	10.0	
Lake Vermilion Nitrate (mg/l as N)	12.7 (avg) 15.6 (max)	
Period of Nitrate Treatment (days) (Averaged over a 3 year Period)	90	

Additional criteria to be considered include capital, operation, and maintenance costs, waste disposal costs, and ease of operation. These criteria form the basis for comparing the alternatives to one another. The water quality goals, determined by maximum contaminant levels, are absolute. That is, any alternative not capable of meeting these goals cannot be considered further. On the other hand, the cost and operational criteria are relative costs that must be judged more subjectively.

The design criteria were developed utilizing historical plant data for the years of 1992 through 1999. In 1991, the level of the Lake Vermilion basin was raised, which altered the water quality of the lake by decreasing nitrate and turbidity levels. Therefore, plant data prior to 1992 was not used because it did not accurately represent the current water quality conditions. However, data from 1992 resulted in a 186 consecutive day period of high nitrate concentrations. Due to the raising of the dam in 1991, associated flooding, washing, and creation of wetlands occurred. When the new wetlands were allowed to develop, the nitrate levels decreased as the wetlands help to capture the nitrates before they reach the water source. Therefore, the 1992 data was not relied upon when determining the design criteria as it did not reflect the current nitrate situation. Instead, data from 1993 to 1999 was used to develop the design criteria regarding the required number of treatment days.

The nitrate concentrations for the historical period analyzed are shown graphically in Exhibits 7-1 through 7-8. From the graphical representations, the typical yearly nitrate trends include elevated levels during the late winter and early spring months lasting through the middle of June or beginning of July.

In the historical analysis, daily in-house nitrate readings are shown as opposed to the weekly IEPA nitrate data. The in-house nitrate levels were generally more conservative than the IEPA data showing higher peak nitrate concentrations, and the duration of high nitrate events were better defined by the more frequent nitrate readings.

The finished water flow was set at 10 mgd, which represents a value conservatively above the average daily flow during the periods of high nitrates. The finished water nitrate concentration of 10 mg/l is the maximum contaminant level allowed by law; therefore a goal of 9 mg/l or less was set to provide a margin of safety.

The Lake Vermilion nitrate concentrations of 12.7 and 15.6 mg/l, are the average and the maximum nitrate concentrations found during high nitrate events, respectively. Although the daily in-house readings show a maximum concentration of over 16 mg/l, based on consultation with the IEPA, a maximum nitrate concentration of 15.6 mg/l, as recorded by the IEPA was used for design purposes.

The annual period of operation represents the approximate total number of days per year on an annualized basis that the nitrate treatment alternative would be in operation. This value was set at 90 days averaged over a three year period, based on the total days per year with nitrate events of 9 mg/l or greater. Based on historical data, in certain years the nitrate treatment may not be operated at all, but in the following year it may be necessary to operate as frequent as 90 days. This value is reflective of data for the last few years of operation, which indicates a trend of less severe nitrate problems since the raising of the dam in 1992 and the creation of the wetlands. Additionally, CIWC has been working with the Lake Vermilion Water Quality Coalition (a water protection group whose purpose is to improve water quality in Lake Vermilion) to reduce the amount of nitrates that flow into the lake. See Table 7-2 for data showing the number of nitrate violations, the number of days duration of the violations and number of days with nitrate concentrations greater than 9.0 mg/l from 1993 to present. This can be contrasted with more severe nitrate problems in the five years prior to 1993. See Table 7-3 for the same data in the years 1988-1992.

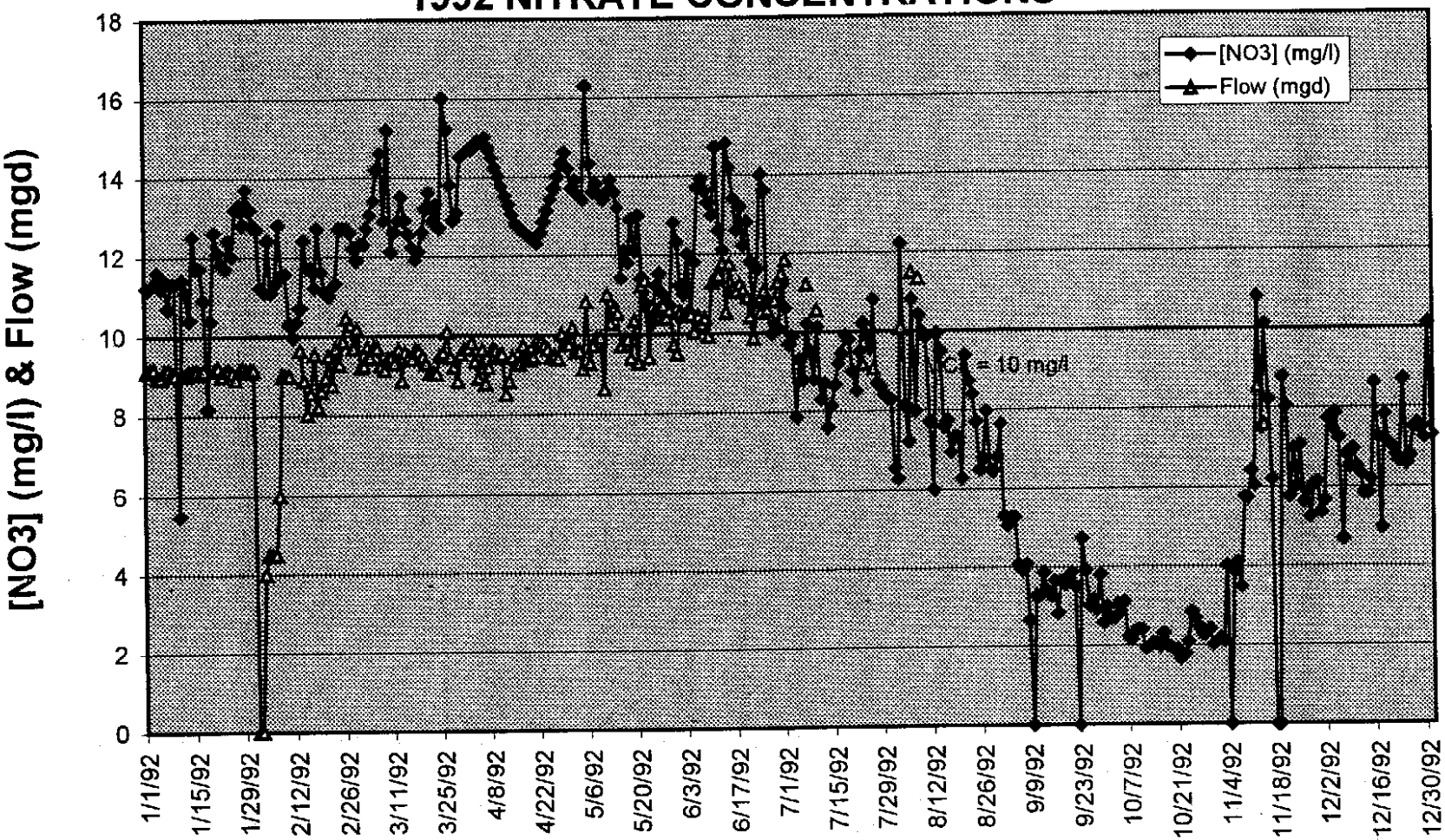
TABLE 7-2
NITRATE DATA
1993 – 1999

Year	No. of Violations	Days of Duration Violation(s)	No. of Days Above 9.0 mg/l
1993	0	0	0
1994	0	0	0
1995	0	0	1
1996	1	48	63
1997	1	7	21
1998	0	0	56
1999	2	21	91

TABLE 7-3
NITRATE DATA
1988 – 1992

Year	No. of Violations	Days of Duration Violation(s)	No. of Days Above 9.0 mg/l
1988	1	21	91
1989	1	148	168
1990	4	102	196
1991	2	20	98
1992	2	186	189

EXHIBIT 7-1
1992 NITRATE CONCENTRATIONS



NOTE: Daily in-house nitrate data was used for exhibit in lieu of the IEPA weekly data.

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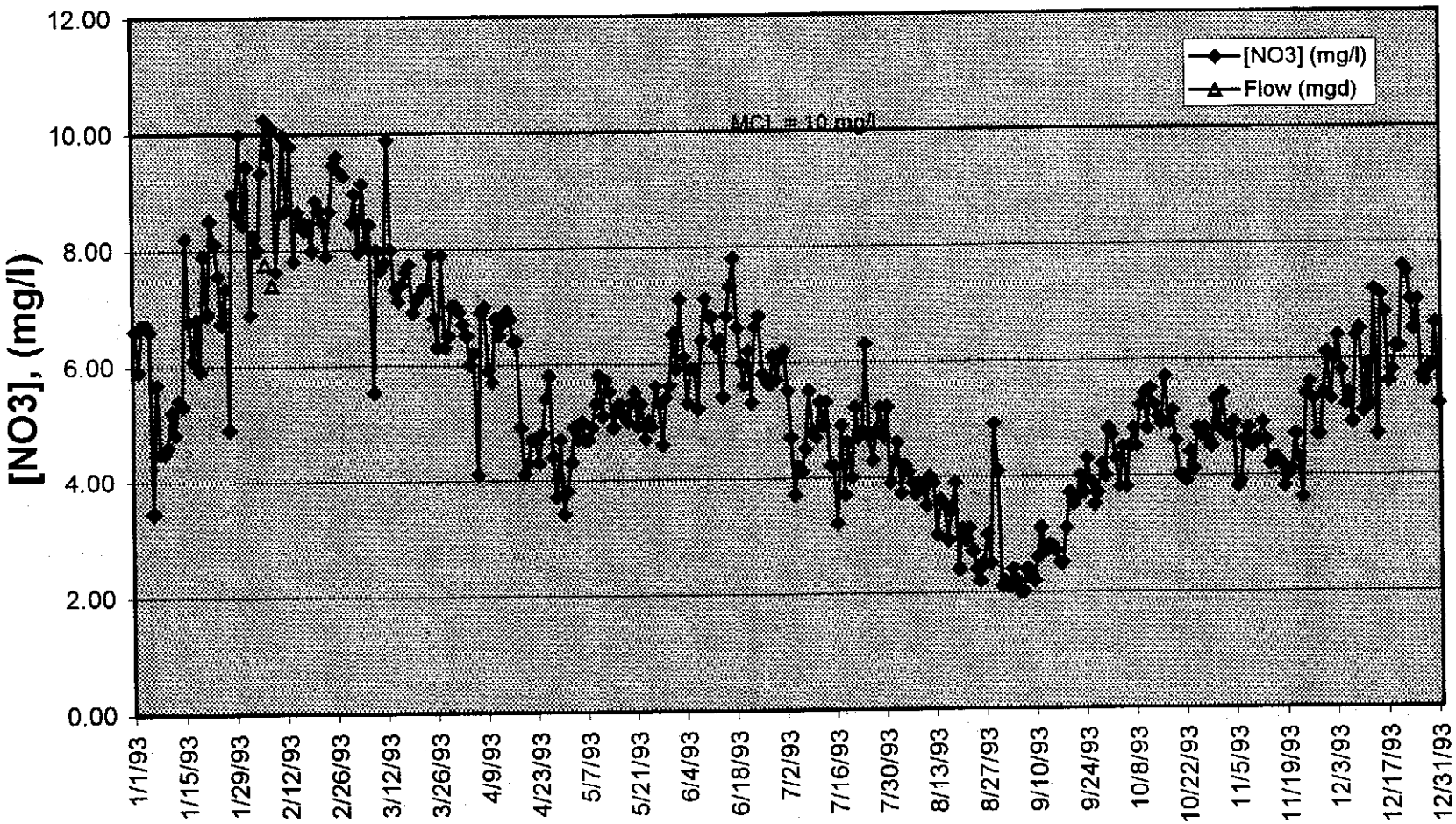
EXHIBIT 7-2
1993 NITRATE CONCENTRATIONS



NOTE: Daily in-house nitrate data was used for exhibit in lieu of the IEPA weekly data.

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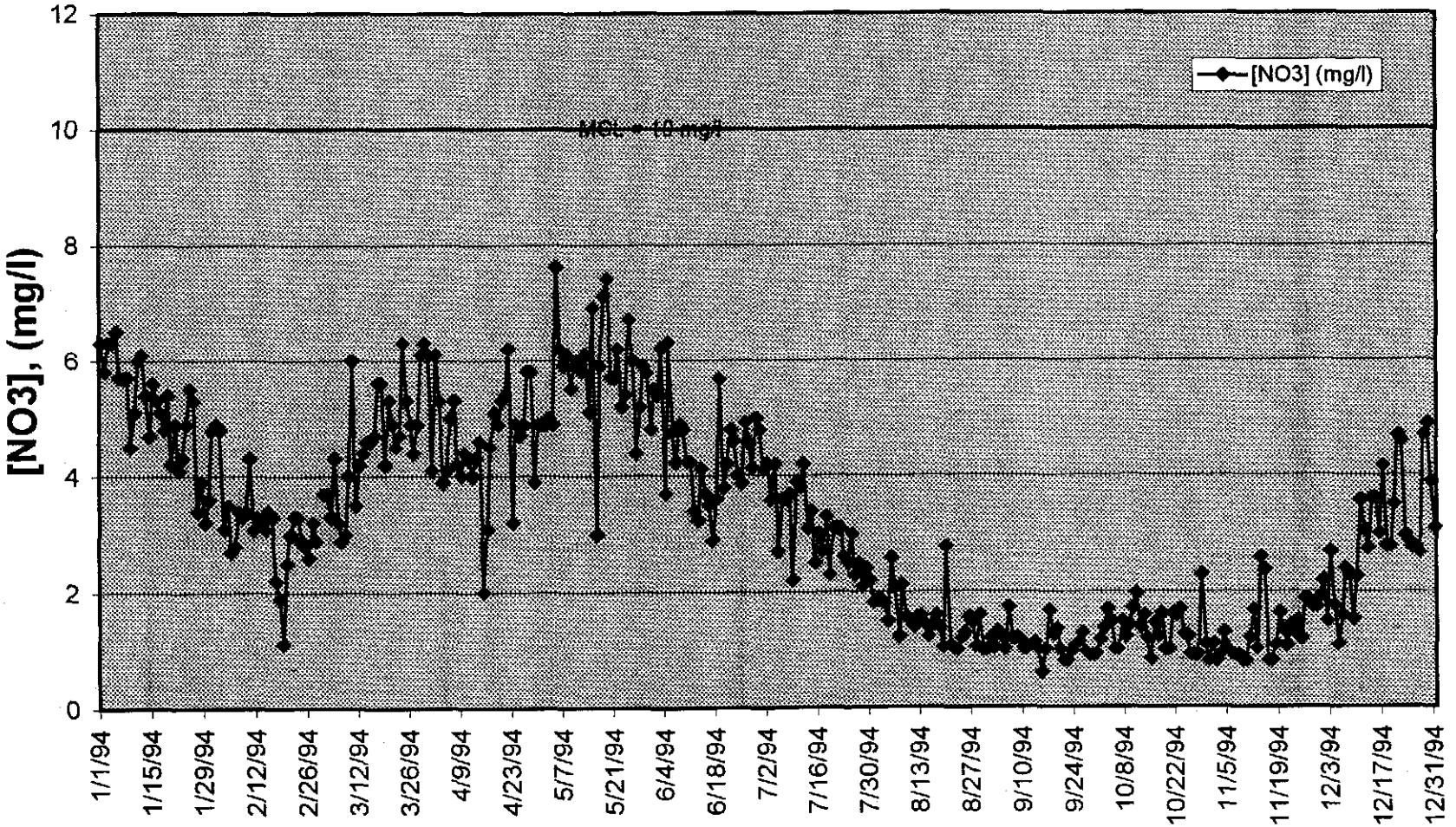
EXHIBIT 7-3
1994 NITRATE CONCENTRATIONS



NOTE: Daily in-house nitrate data was used for exhibit in lieu of the IEPA weekly data.

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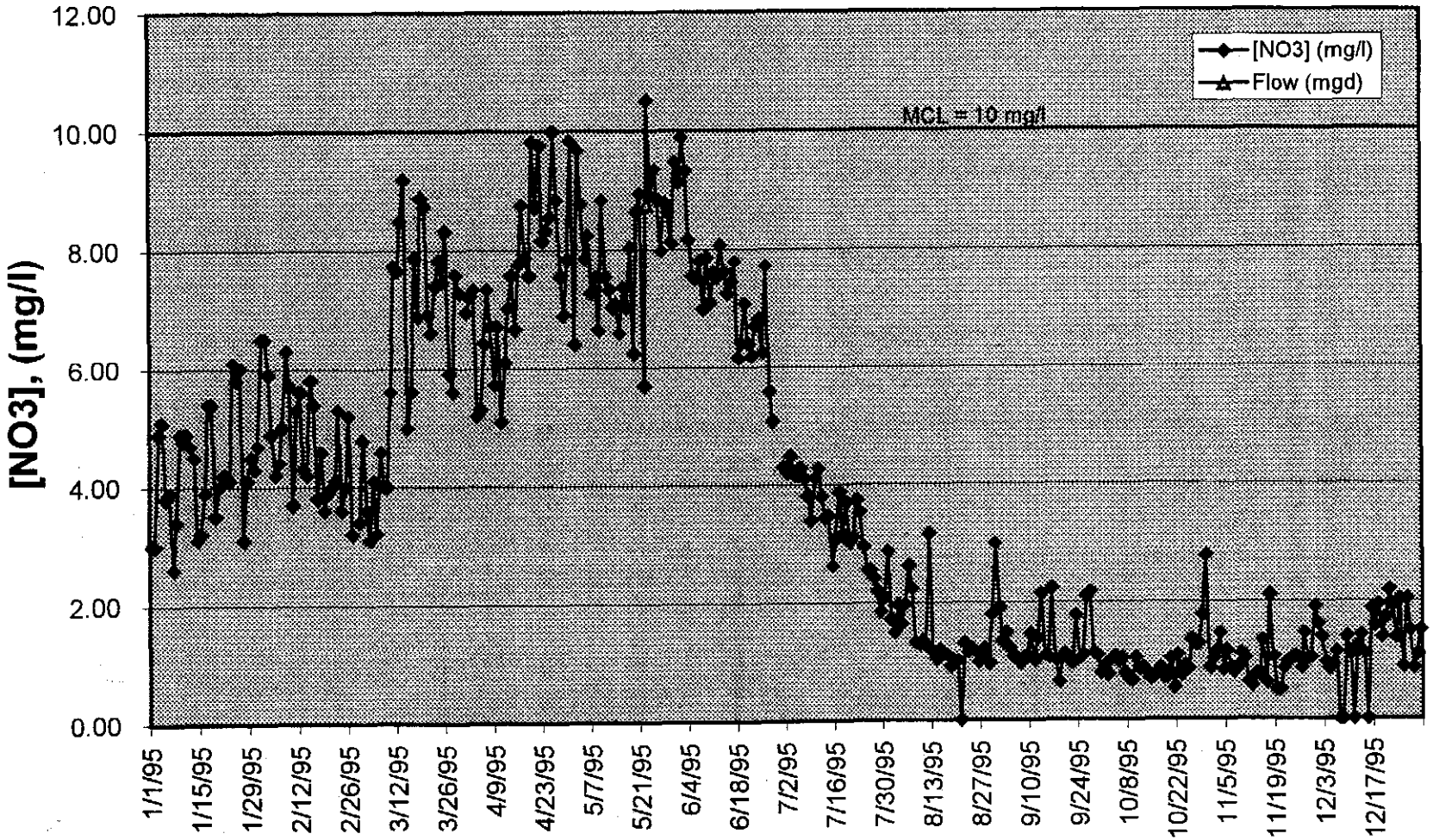
EXHIBIT 7-4
1995 NITRATE CONCENTRATIONS



NOTE: Daily in-house nitrate data was used for exhibit in lieu of the IEPA weekly data.

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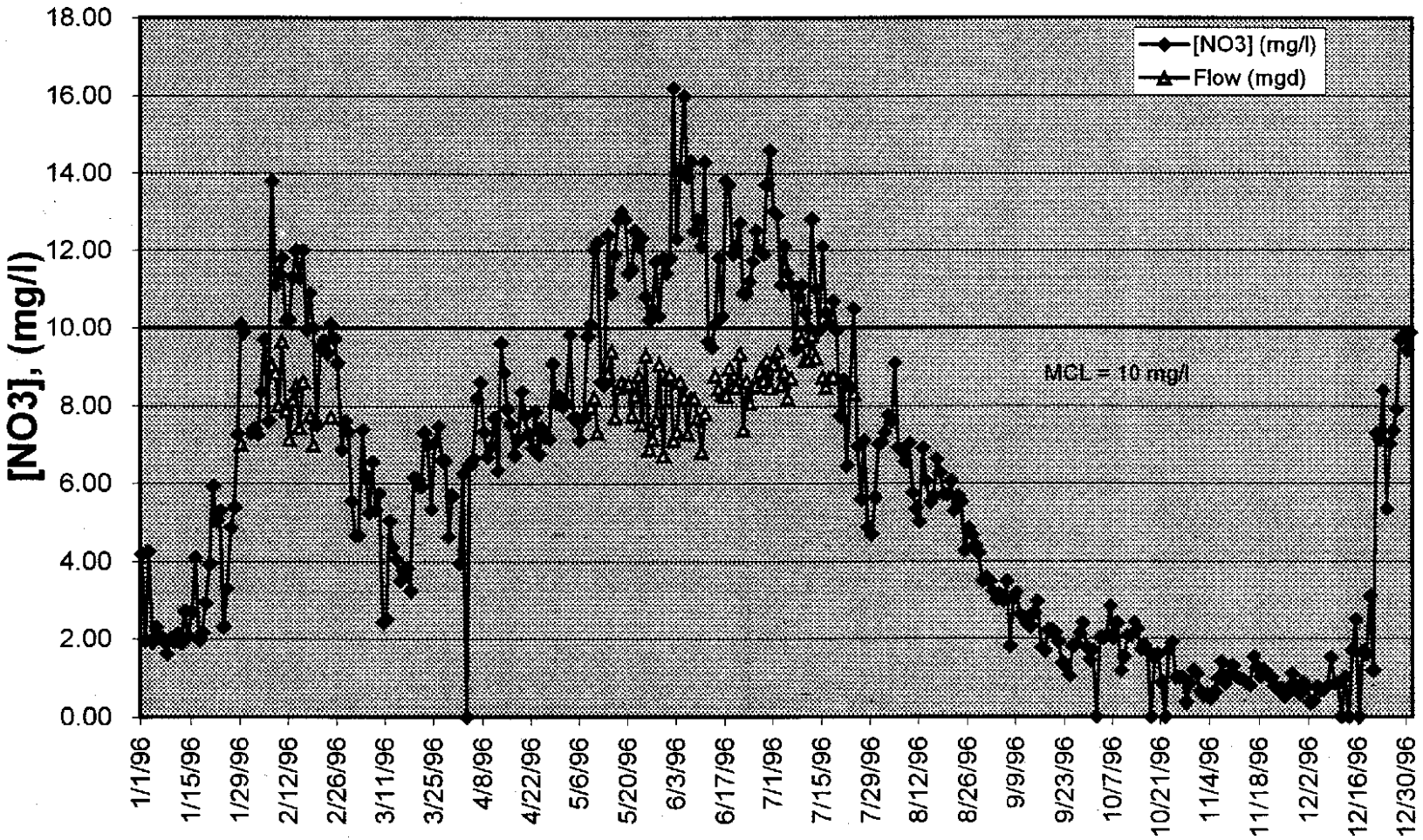
EXHIBIT 7-5
1996 NITRATE CONCENTRATIONS



NOTE: Daily in-house nitrate data was used for exhibit in lieu of the IEPA weekly data.

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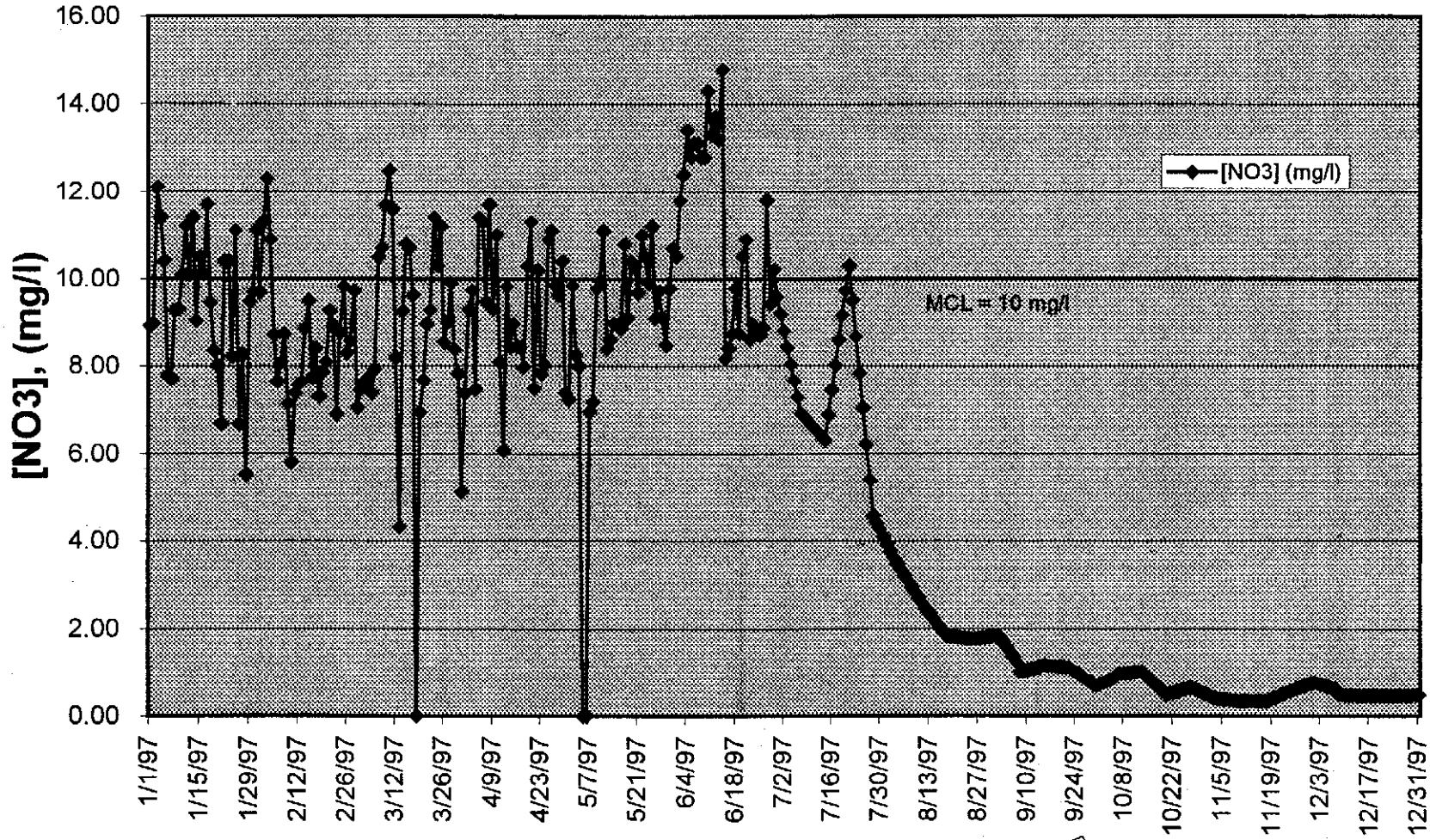
EXHIBIT 7-6
1997 NITRATE CONCENTRATIONS



NOTE: Daily in-house nitrate data was used for exhibit in lieu of the IEPA weekly data.

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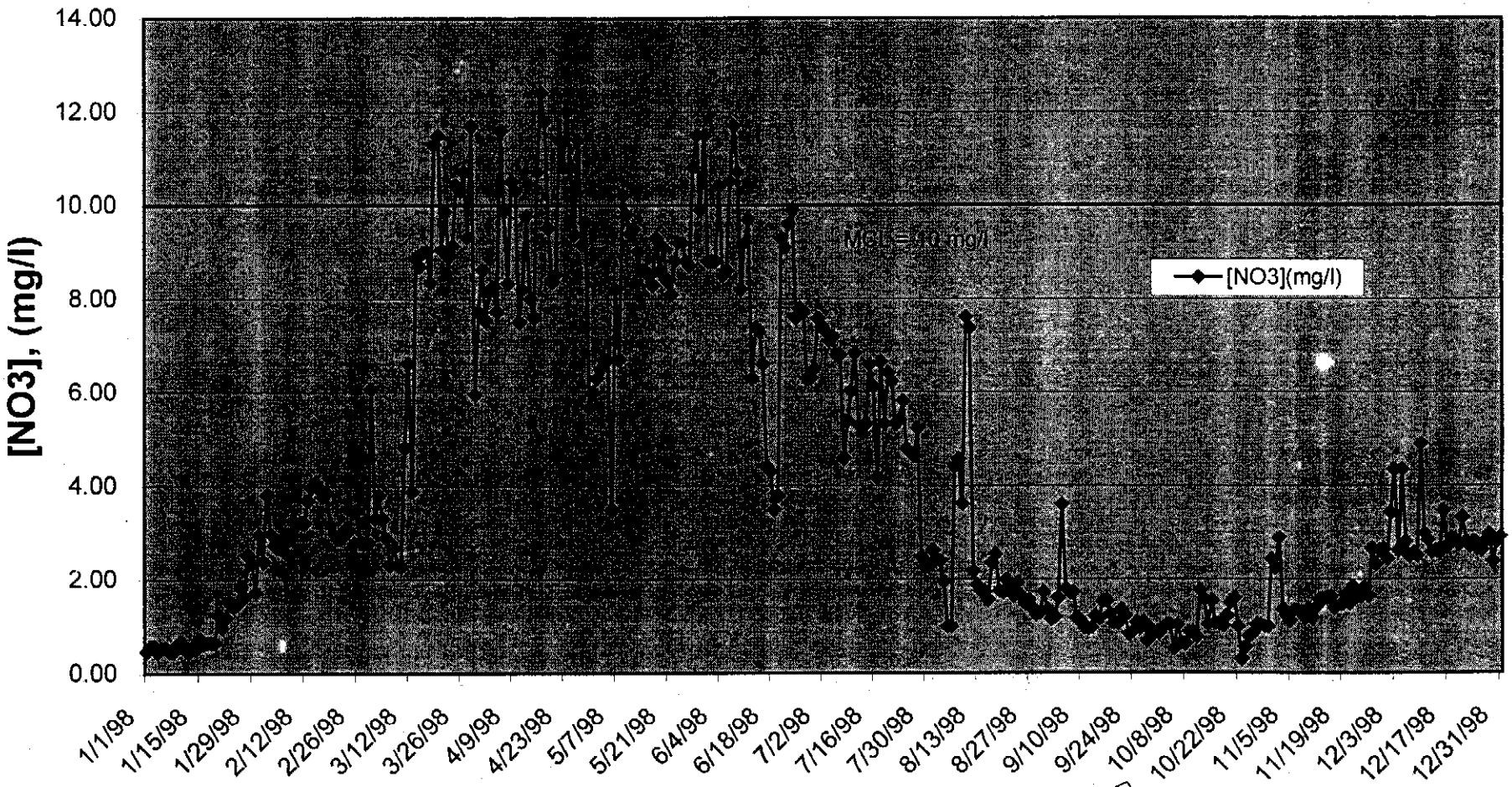
EXHIBIT 7-7
1998 NITRATE CONCENTRATIONS



NOTE: Daily in-house nitrate data was used for exhibit in lieu of the IEPA weekly data.

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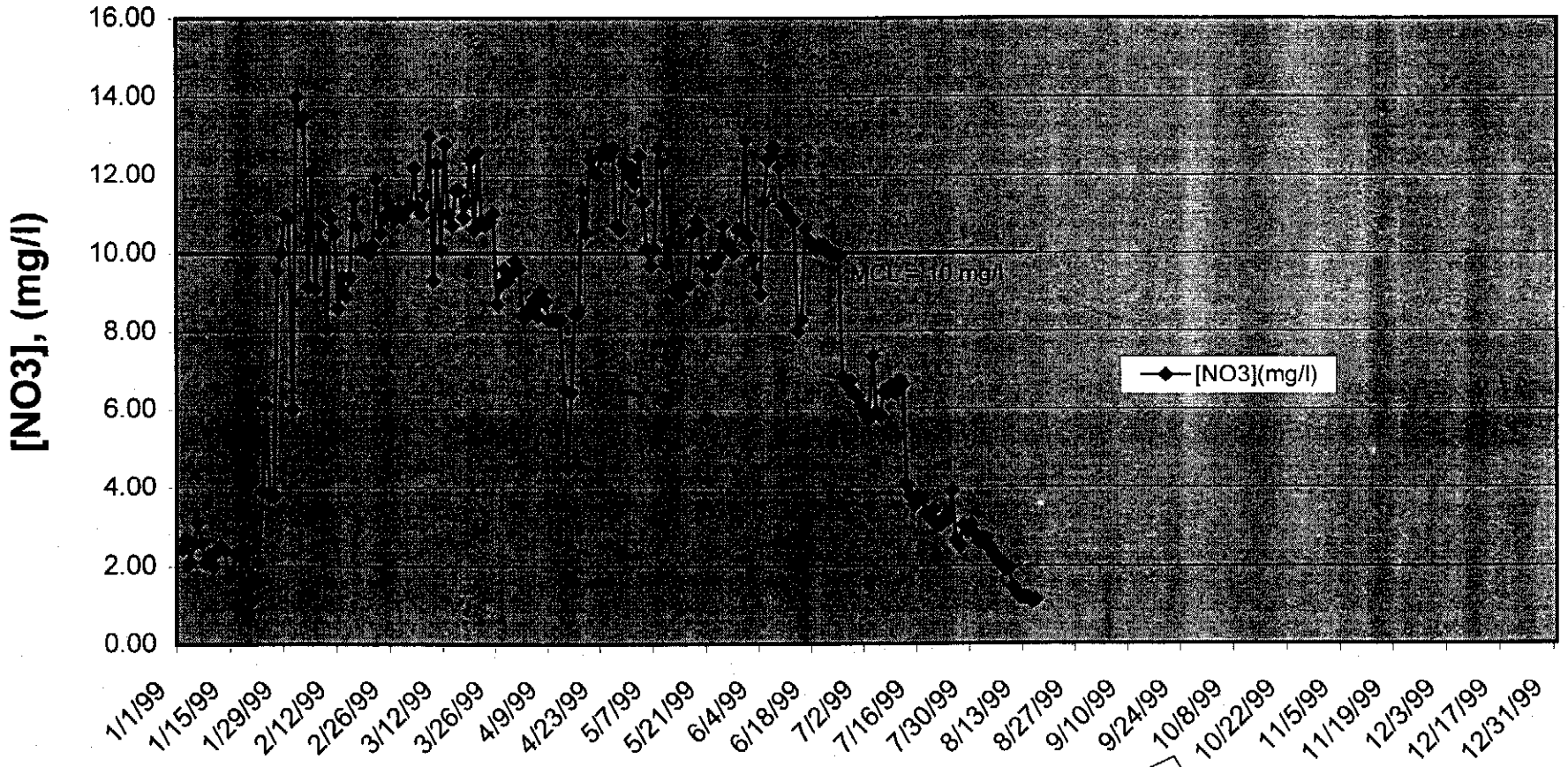
EXHIBIT 7-8
1999 NITRATE CONCENTRATIONS



NOTE: Daily in-house nitrate data was used for exhibit in lieu of the IEPA weekly data.

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